spectacle lens, and the increased power necessary in the spectacle lens.

Line D represents the IOL/spectacle combination with a vertex distance of 23 mm for the spectacle. This additional 10 mm of vertex distance is seen to give a significant increase in magnification compared to line A. There are two implications to this observation. First, a given magnification can be for a spectacle lens diameter of 40 mm., and a 7 mm. distance between the cornea and nodal point of the eye, a spectacle lens power of 21.4 diopters will yield a field of view of about 26.84° using the above formula. Thus, fields of view of 27° or greater are possible achieved with a lower power IOL and lower power spectacle lens if the vertex distance can be somewhat greater than the standard 13 mm. Second, and perhaps more important, after an IOL has been in place for a few years, the patient may require increased magnification, due to progressive macular degeneration. Rather than risk a second operation to replace the IOL, the patient can be fitted with spectacles having a greater vertex distance. For example, if the IOL were a −60 D lens, the initial magnification for a vertex distance of 13 mm would be 1.97×. Later the magnification could be increased to 2.5× by increasing the vertex distance to 23 mm, together with an appropriate change in the power of the spectacle lens. While an increase in vertex distance does create minor problems in fitting spectacle lenses and in cosmetic appearance, the disadvantages are less objectionable than the traditional telescopic spectacles or hand-held telescopes.

As seen from the information provided by the graphs, the system of the invention provides improved magnification and increased field of vision over systems which are commonly available, while being easier to use and being far more cosmetically acceptable. As was noted previously, it is a significant advantage of the invention that, for a given magnification, the intraocular lens-spectacle combination provides a larger field of view than any of the alternatives shown in FIG. 4.

Additional advantages of the inventive combination are lighter weight, and fewer optical elements to be maintained in alignment. Cosmetically, a simple lens in front of the eye, even a strong positive lens, is less objectionable than a telescope mounted on the spectacle frame, as is presently employed.

The advantages of a system providing a wide field of view are obvious. A wide field greatly increases the ability of the patient to move about, to avoid obstacles, and generally to function normally, and, therefore, provides a viable alternative to systems which have been proposed previously.

As has been noted above, the intraocular lens may be used in combination with a contact lens instead of a spectacle lens (FIG. 8). The negative intraocular lens and positive contact lens once again act to form a Galilean telescope. However, this embodiment is less preferred by virture of the shorter spacing between the two lenses, as compared with the spacing between the intraocular lens and a spectacle lens. The magnification which is obtained is, therefore, quite limited and fixed, as a result of the anatomy of the eye.

In yet another embodiment of the invention (FIG. 10), a negative contact lens may be used in combination with a negative intraocular lens and a positive spectacle lens to satisfy the parameters set forth previously. However, by virtue of the extra problems associated with contact lens wear, as well as the additional problems of alignment of the three lenses, this system is likewise less preferable than the simple intraocular lens-spectacle lens system.

An additional embodiment of the invention employs a positive contact lens in combination with a positive spectacle lens and a negative intraocular lens. By dividing the required positive power between the spectacle lens and the contact lens, the power of the spectacle lens can be reduced, thus reducing its weight and improving the cosmetic appearance. Furthermore, for a given magnification, the field of view is somewhat greater for the combination including the positive contact lens than for the spectacle/IOL combination.

FIG. 7 illustrates an alternative embodiment of the invention which is useful with patients suffering from reduced peripheral vision. In this embodiment, the IOL and external lens powers are reversed such that the IOL 9' has a positive power while the external lens 7' has a negative power. A graph similar to that shown in FIG. 5 may be used for selecting various lens powers after the patient's visual requirements have been evaluated. By way of example, in this embodiment an IOL having a power of 40D in combination with a spectacle lens of −25D power at a vertex distance of 23 mm gives a magnification of 0.59.

Although the invention has been described with respect to particular materials, lenses, and intraocular lens systems, it is to be understood that the invention is not limited to the particulars disclosed, but extends to all equivalents falling within the scope of the claims.

We claim:

1. An intraocular lens sized and shaped for implantation in the posterior chamber of the eye, said lens comprising a negative-powered intraocular section having a power and being configured so as to provide substantial magnification of the retinal image and adapted to be used in combination with an external positive lens.

2. The intraocular lens as defined by claim 1, said lens having a power and being configured so as to provide a wide field of vision when used in combination with said external positive lens.

3. The intraocular lens as defined by claim 1 wherein said lens is provided with flexible support members adapted to position the lens in the posterior chamber of the eye.

4. The intraocular lens as defined by claim 1 wherein said lens has a negative power of at least −10 diopters.

5. The intraocular lens as defined by claim 4 wherein said lens has a negative power of at least −40 diopters.

6. An optical system comprising:

a) an intraocular lens comprising a negative-powered section sized and shaped for implantation within the posterior chamber of an eye; and

b) an external lens; whereby said intraocular lens and said external lens in combination have a power and are configured so as to provide substantial magnification of the retinal image.

7. The optical system as defined by claim 6 wherein said external lens is a spectacle lens having a positive power so as to magnify the image on the retina of the eye.

8. The optical system as defined by claim 6 wherein said external lens is a positive contact lens.

9. The optical system as defined by claim 6 wherein said external lens is a positive Fresnel lens.

10. The optical system as defined by claim 6 further comprising a second external lens, and wherein said first